Submitted To AECOM Canada Ltd.
189 Wyld Street Suite 103, North Bay, Ontario P1B 1Z2
On Behalf of the Ontario Ministry of Transportation

Highway 144 Rehabilitation
Bridge Rehabilitation – Site No. 46-237
Bailey Creek Bridge
Twp. of Ulster
GWP 5046-05-00

Highway 144
From Cartier West Entrance (Centre Street),
Northerly 24.8 km

FINAL FOUNDATION INVESTIGATION REPORT

Date: September 21, 2012
Ref. Nº: 11/06/11101-F4

Geocres No. 42I-288

LVM | MERLEX
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1.0 INTRODUCTION

LVM | MERLEX has been retained by AECOM Canada Ltd., on behalf of the Ministry of Transportation of Ontario (MTO), to carry out a foundation investigation to supply subsurface data for the design of a protection system to be implemented at the Bailey River Bridge during the proposed rehabilitation. This bridge is located on Highway 144, some 20.6 km north of Cartier, in the Township of Ulster. The existing bridge is a 25.2 m single span concrete girder bridge with a width of 10.4 m.

The foundation investigation location was specified by the MTO in the RFP/TPM documentation Agreement No. 5010-E-0012. The terms of reference for the scope of work are outlined in MEL's proposal P-10-177, dated January, 2011. The purpose of this investigation was to determine the subsurface conditions in the areas of the bridge approaches in order to provide design recommendations for a protection system to be implemented during rehabilitation activities to convert to semi-integral abutments. LVM | MERLEX investigated the foundation areas by the drilling of boreholes, carrying out in-situ tests, and performing laboratory testing on select samples.

2.0 SITE DESCRIPTION

The Bailey Creek Bridge is located on Highway 144, between Stations 18+262.5 to 18+287.7, Township of Ulster (Site No. 46-237). The topography at the site is generally of low relief. The existing highway embankment currently supports two undivided lanes of highway, running in a north south direction. Bailey Creek flows from west to east at the bridge location. A visual review of the highway at the north and south approaches indicates that, in general, the approaches are in fair condition. Cobble and boulder size rock is present in the existing stream bed.

The existing 25.2 m single span concrete deck bridge was constructed in 1967 and rehabilitated in 1984 on the original highway alignment. The structure is in fair condition with deterioration of the concrete in some elements, including the wing walls and abutments.

Infrastructure at the bridge location consists of overhead communication wires on the east (right) side of the highway.

2.1 Site Physiography and Surficial Geology

This project is located in the Geomorphic Sub-province known as the Eastern Sandy Uplands. The topography on this section of Highway 144 is generally rolling. There are exposed bedrock ridges. At many locations, significant layers of earth overlay the bedrock. Organic terrain was also observed. Within the project area overburden consists primarily of sand and gravel containing varying amounts of silt and clay.

Bedrock in the area, as indicated on OGS Map 2506, is of the Early Precambrian Era. At the location of this bridge foundation investigation, the bedrock comprises of Felsic Igneous and Metamorphic Rocks including: granitic rocks, syenite, pegmatite, and unsubdivided migmatite.

3.0 INVESTIGATION PROCEDURES

The fieldwork for this investigation was carried out between September 18th and October 17th, 2011, during which four (4) sampled boreholes were advanced. Two boreholes were advanced at each end of the bridge: one through the existing approach slab and the second a short distance beyond the end of the approach slab. Additionally, pre-coring of the approach slabs at both ends of the bridge, directly behind the abutments, was undertaken to allow boreholes to be advanced at a future date. However, work at the abutments, by the Regional MTO Contractor, was carried out between the time of pre-coring the approach slabs and the investigation with the

auger drill, during which the approach slabs, left of centerline (southbound lane), were in the process of reconstruction. As such Boreholes Nos. 5 and 6 were not advanced through the newly replaced approach slab.

The field investigation was carried out using a truck mounted CME drilling rig equipped with hollow stem augers, standard augers, and routine geotechnical sampling equipment. Prior to mobilizing the auger drill to the site, the concrete approach slabs were core drilled, where required, with an electric core drill. Soil samples were obtained at the borehole locations at regular intervals of depth using the standard 50 mm O.D. split spoon sampler advanced in accordance with the Standard Penetration Test (SPT) procedures (ASTM D-1586). The SPT method involves advancing a 50 mm O.D. split spoon sampler with the force of a 63.5 kg hammer freely dropping 760 mm mounted in a trip (automatic) hammer. The number of blows per 300 mm penetration was recorded as the “N” value. At the boreholes, a Dynamic Cone Penetration Test (DCPT) was carried out to give a continuous plot of the soil resistance with depth. When cohesive deposits were encountered, the in-situ strength was measured using an “N” size field vane, vane collar, and calibrated torque meter. All samples taken during this investigation were stored in labeled airtight containers for transport to our North Bay laboratory for visual examination and select laboratory testing.

Groundwater conditions in the open boreholes were observed during the advancement of, and immediately following, completion of the individual boreholes. All open boreholes were backfilled upon completion with compacted auger cuttings in the general order they were removed and the upper portion of the hole, where necessary, was backfilled with an asphalt cold patch to seal the existing asphalt surface. The field work for this investigation was under the full time direction of a senior member of our engineering staff, who was responsible for locating the boreholes, clearing the borehole locations of underground services, in-situ sampling and testing operations,

logging of the boreholes, labeling and preparation of samples for transport to our North Bay laboratory, plus overall drill supervision. All samples received a visual confirmatory inspection in our laboratory. Laboratory testing of select samples included routine testing for natural moisture content determination and particle size analysis. The results of the laboratory testing are presented on the individual Record of Borehole Sheets (Appendix B), with a summary of results presented on the laboratory sheets in Appendix C (Figure No. L-1).

The location of the individual boreholes were determined in the field using highway chainage (established by others) and offset relative to highway centerline. The MTO co-ordinates, northing and easting, were then established for the boring locations. Elevations contained in this report are referenced to a geodetic datum.

4.0 SUBSURFACE CONDITIONS

Details of the subsurface conditions revealed by the investigation program are presented on the enclosed Record of Borehole Logs (Appendix B) and on Figure No. 2 (Appendix C). Please note that stratigraphic delineation presented on the borehole logs and soil strata plot are the results of non-continuous sampling, response to drilling progress, the results of SPT and Dynamic Cone Penetration Test (DCPT), plus field observations. Typically such boundaries represent transitions from one zone to another and are not an exact demarcation of a specific geological unit. Additional consideration should be given to the fact that subsurface conditions may vary markedly between adjacent boreholes and beyond any specific boring location, and are shown on the drawings for illustration purposes only.

4.1 Bailey Creek Bridge, TWP of Ulster – Site No. 46-237

A plan and profile illustrating the borehole locations and stratigraphic sequences is shown on Figure No. 2, Appendix C. During the course of the exploration program, four (4) sampled

boreholes were put down at this site, with Borehole No. 1 advanced to the south of the south approach slab right of centerline. Borehole No. 2 was advanced behind the south abutment right of centerline. Borehole No. 3 was advanced behind the north abutment to the right of centerline, and Borehole No. 4 was advanced to the north of the north approach slab, left of centerline. At the time of the subsurface investigation, the ground surface elevations at Boreholes Nos. 1 to 4 were recorded at 408.5, 408.6, 408.7, and 408.7 m, respectively.

4.1.1 Pavement Structure

At surface at Borehole Nos. 1 and 4, a surficial pavement structure consisting of 100 to 125 mm of asphalt overlying 125 to 150 mm of crushed gravel was encountered. At surface at Borehole Nos. 2, 3, 5, and 6, a pavement structure consisting of 50 to 100 mm of asphalt overlying a 275 to 350 mm thick concrete approach slab, overlying 150 to 200 mm of crushed gravel was penetrated.

4.1.2 Fill

Underlying the pavement structure and approach slab at each borehole, a deposit of fill consisting of brown gravel and sand trace silt was penetrated. Numerous cobbles and boulder size rock was encountered in the lower reaches of this deposit, as such the fill was identified as rock fill. The natural moisture content measured on samples of this deposit was in the order of 1 to 9%. Gradation analyses were carried out on four (4) samples of the granular portion of this deposit, the results of which indicated 43 to 66% gravel size particles, 26 to 53% sand size particles, and 4 to 9% silt and clay size particles (Figure No. L-1, Appendix C). Based on SPT ‘N’ values of 11 to 65 blows per 300 mm penetration, the compactness of this deposit was described as compact to very dense, generally compact. Auger refusal was encountered on cobble/boulder size rock in this deposit at depths of 2.5, 2.0, 1.4, and 1.4 m below grade at Borehole Nos. 1 to 4, respectively (elevations 406.0, 406.6, 407.3, and 407.3 m, respectively).

DCPT refusal was encountered in this deposit at depths of 0.6, 3.9, 2.9, and 5.3 m below existing grade at Borehole Nos. 1 to 4, respectively (elevations 407.9, 404.7, 405.8, 403.4 m, respectively).

4.1.3 Previous Investigations

Based on information obtained from Contract No. 67-98 and Foundation Investigation Report W.J. 66-F-60, dated July 11, 1960, the overburden at this site generally consisted of boulders overlying a mix of sand, gravel and boulders with bedrock at an approximate elevation of 396.5 m. The original ground surface was at approximately elevations 404.5 and 403.5 m to the south and north of the stream channel. The embankment was constructed over the boulder bed using rock fill. The Bailey Creek contract drawings, from Contract No. 67-98 have been included, for general information, as Enclosure Nos. 6 and 7 in Appendix D.

4.2 Groundwater Conditions

During this investigation, the water level in the river was measured at an elevation of 403.4 m, based on the survey by exp. Measurements of the groundwater table and cave-in levels were undertaken, where possible, in the open boreholes during the advance of the individual borings and upon completion. These levels are recorded on the individual Record of Borehole Log Sheets (Appendix B). Borehole Nos. 1 to 4 were dry upon completion and were backfilled immediately upon completion of sampling. The groundwater levels will fluctuate seasonally.

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M. A. Merleau, P. Eng.
Principal Engineer
MTO Designate

J. R. Berghamer, P. Eng.
Regional Manager

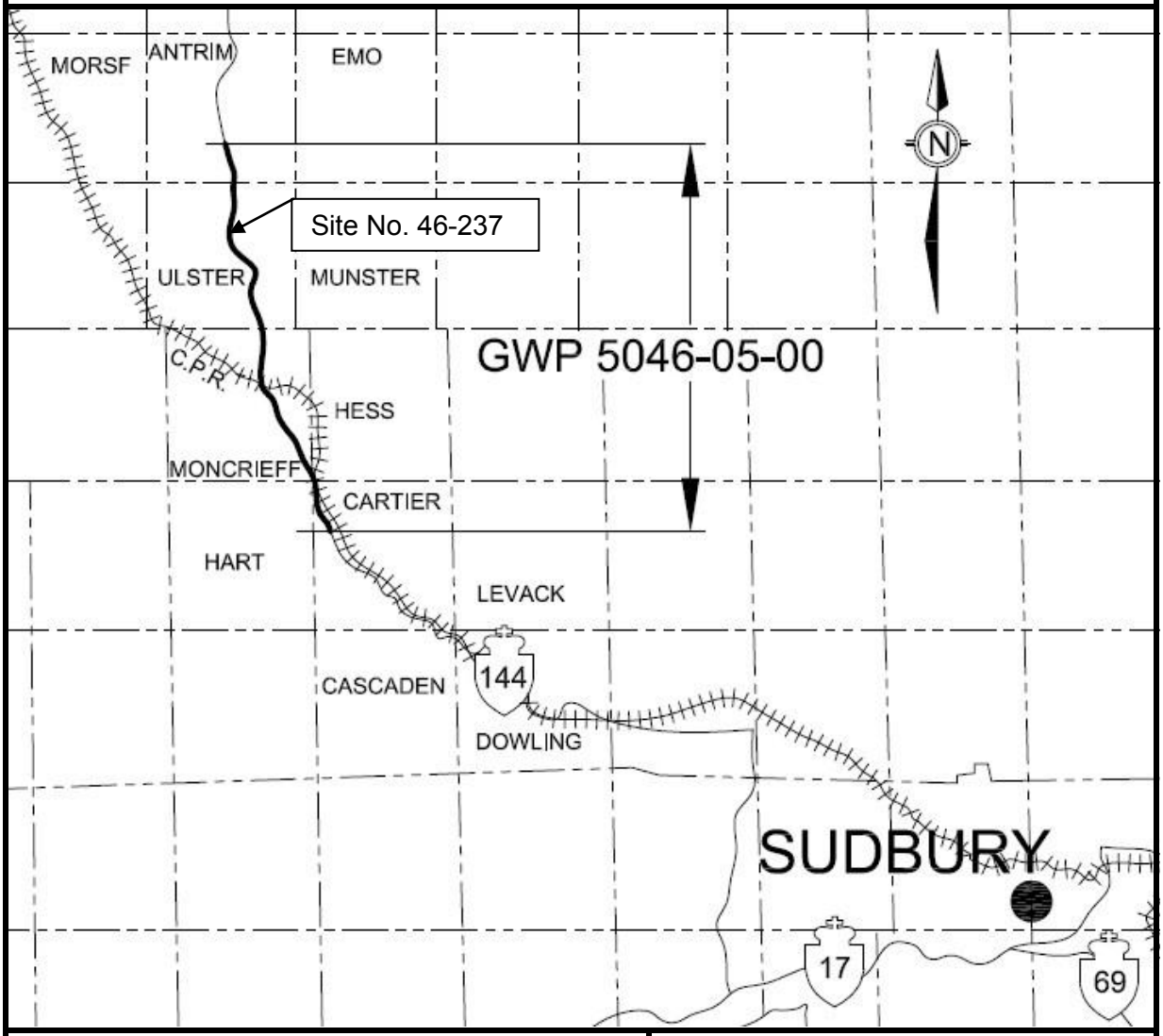
Appendix A Key Plan

Figure No. 1: Key Plan

KEY PLAN

Figure No. 1

NOT TO SCALE



FINAL FOUNDATION INVESTIGATION REPORT
GWP 5046-05-00

Highway 144

From Cartier West Entrance (Centre Street)
Northerly 24.8 km

Ref. No.: 11/06/11101-F4

September 2012

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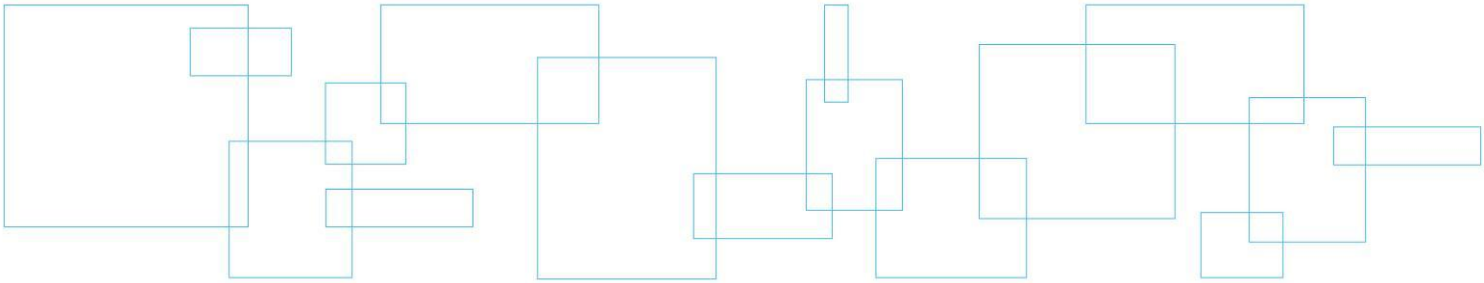
Appendix B Abbreviations
Record of Borehole Sheets

Enclosure No. 1: List of Abbreviations and Symbols

Enclosure Nos. 2 to 7: Record of Borehole Sheets



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LIST OF ABBREVIATIONS & DESCRIPTION OF TERMS

The abbreviations and terms, used to describe retrieved samples and commonly employed on the borehole logs, on the figures and in the report are as follows:

1. ABBREVIATIONS

AS Auger Sample
CS Chunk Sample
DS Denison type sample
FS Foil Sample
NFP No Further Progress
PH Sampler advanced by hydraulic pressure
PM Sampler advanced by manual pressure
RC Rock core with size & percentage of recovery
SS Split Spoon
ST Slotted Tube
TO Thin-walled, open
TP Thin-walled, piston
WS Wash Sample

2. PENETRATION RESISTANCE/"N"

Dynamic Cone Penetration Test (DCPT):

A continuous profile showing the number of blows for each 300 mm of penetration of a 50 mm diameter 60° cone attached to AW rod driven by a 63 kg hammer falling 760 mm.

Plotted as —•—•—•—•

Standard Penetration Test (SPT) or "N" Values

The number of blows of a 63 kg hammer falling 760 mm required to advance a 50 mm O.D. drive open sampler 300 mm.

3. SOIL DESCRIPTION

a) *Cohesionless Soils:*

"N" (blows/0.3 m)	*Relative Density*
0 to 4	very loose
4 to 10	loose
10 to 30	compact
30 to 50	dense
over 50	very dense

b) *Cohesive Soils:*

Undrained Shear Strength (kPa)	*Consistency*
Less than 12	very soft
12 to 25	soft
25 to 50	firm
50 to 100	stiff
100 to 200	very stiff
over 200	hard

3. SOIL DESCRIPTION (Cont'd)

c) *Method of Determination of Undrained Shear Strength of Cohesive Soils:*

+ 3.2 - Field Vane test in borehole. The number denotes the sensitivity to remoulding.

D - Laboratory Vane Test

¨ - Compression test in laboratory

For a saturated cohesive soil the undrained shear strength is taken as one-half of the undrained compressive strength.

4. TERMINOLOGY

Terminology used for describing soil strata is based on the proportion of individual particle sizes present in the samples (please note that, with the exception of those samples subject to a grain-size analysis, all samples were classified visually and the accuracy of visual examination is not sufficient to determine exact grain sizing):

Trace, or occasional	Less than 10%
Some	10 to 20%
With	20 to 30%
Adjective (i.e. silty or sandy)	30 to 40%
And (i.e. sand and gravel)	40 to 60%

Terminology for cobbles and boulders is based on auger response and field observations:

Occasional	Obstructions encountered in borehole, however advance is not impeded
Numerous	Obstructions are essentially continuous over drilled length

5. LABORATORY TESTS

P Standard Proctor Test
A Atterberg Limit Test
GS Grain Size Analysis
H Hydrometer Analysis
C Consolidation

SAMPLE DESCRIPTION NOTES:

1. **FILL:** The term fill is used to designate all man-made deposits of natural soil and/or waste materials. The reader is cautioned that fill materials can be very heterogeneous in nature and variable in depth, density and degree of compaction. Fill materials can be expected to contain organics, waste materials, construction materials, shot rock, rip-rap, and/or larger obstructions such as boulders, concrete foundations, slabs, abandoned tanks, etc.; none of which may have been encountered in the borehole. The description of the material penetrated in the borehole therefore may not be applicable as a general description of the fill material on the site as boreholes cannot accurately define the nature of fill material. During the boring and sampling process, retrieved samples may have certain characteristics that identify them as 'fill'. Fill materials (or possible fill materials) will be designated on the Borehole Logs. If fill material is identified on the site, it is highly recommended that testpits be put down to delineate the nature of the fill material. However, even through the use of testpits defining the true nature and composition of the fill material cannot be guaranteed. Fill deposits often contain pockets or seams of organics, organically contaminated soils or other deleterious material that can cause settlement or result in the production of methane gas. It should be noted that the origins and history of fill material is frequently very vague or non-existent. Often fill material may be contaminated beyond environmental guidelines and the material will have to be disposed of at a designated site (i.e. registered landfill). Unless requested or stated otherwise in this report, fill material on this site has not been tested for contaminants however, environmental testing of the fill material can be carried out at your request. Detection of underground storage tanks cannot be determined with conventional geotechnical procedures.

2. **TILL:** The term till indicates a material that is an unstratified, glacial deposit, heterogeneous in nature and, as such, may consist of mixtures and pockets of clay, silt, sand, gravel, cobbles and/or boulders. These heterogeneous deposits originate from a geological process associated with glaciation. It must be noted that due to the highly heterogeneous nature of till deposits, the description of the deposit on the borehole log may only be applicable to a very limited area and therefore, caution must be exercised when dealing with a till deposit. When excavating in till, contractors may encounter cobbles/boulders or possibly bedrock even if they are not indicated on the borehole logs. It must be appreciated that conventional geotechnical sampling equipment does not identify the nature or size of any obstruction.

3. **BEDROCK:** Auger refusal may be due to the presence of bedrock, but possibly could also be due to the presence of very dense underlying deposits, boulders or other large obstructions. Auger refusal is defined as the point at which an auger can no longer be practically advanced. It must be appreciated that conventional geotechnical sampling equipment does not differentiate between nature and size of obstructions that prevent further penetration of the boring below grade. Bedrock indicated on the borehole logs will be labeled 'possibly' or 'probable' etc. based on the response of the boring and sampling equipment, surrounding topography, etc. Bedrock can be proven at individual borehole locations, at your request, by diamond core drilling operations or, possibly, by testpits. It must also be appreciated that bedrock surfaces can be, and most times are, very erratic in nature (i.e. sheer drops, isolated rock knobs, etc.) and caution must be used when interpreting subsurface conditions between boreholes. A bedrock profile can be more accurately estimated, at the clients' request, through a series of closely positioned unsampled auger probes combined with core drilling.

4. **GROUNDWATER:** Although the groundwater table may have been encountered during this investigation and the elevation noted in the report and/or on the record of boreholes, it must be appreciated that the elevation of the groundwater table will fluctuate based upon seasonal conditions, localized changes, erratic changes in the underlying soil profile between boreholes, underlying soil layers with highly variable permeabilities, etc. These conditions may affect the design and type and nature of dewatering procedures. Cave-in levels recorded in borings give a general indication of the groundwater level in cohesionless soils however, it must be noted that cave-in levels may also be due to the relative density of the deposit, drilling operations etc.

ENCLOSURE NO.:2 (Pg. 1 of 1)

METRIC

RECORD OF BOREHOLE NO. 1

REFERENCE 11/06/11101-F4 DATUM Geodetic LOCATION N5191666.6 E256459.5 - Ulster Township ORIGINATED BY JL

PROJECT GWP 5046-05-00, Highway 144 - Site No. 46-237 BOREHOLE TYPE Track Mounted CME 45B - Hollow Stem Augers COMPILED BY AT

CLIENT AECOM Inc. DATE (Started) October 17, 2011 TIME (Completed) 1:15:00 PM CHECKED BY MAM

DATE (Completed) October 17, 2011

ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA (SI CL)
408.5	Ground Surface										
0.0 / 407.9	100 mm Asphalt 125 mm Crushed Gravel		1	AS	N/A		408				
0.6	DCPT Refusal FILL - gravel with sand to sandy trace silt numerous cobbles/boulders (rock fill) (compact)		2	SS	19						66 26 (8)
			3	SS	11		407				
406.0			4	SS	30/ 175mm		406				55 40 (5)
2.5	Auger Refusal End of Borehole										

SHEAR STRENGTH kPa: ○ UNCONFINED ● QUICK TRIAXIAL + FIELD VANE × LAB VANE

COMMENTS

The stratification lines represent approximate boundaries. The transition may be gradual.

$+^3$, $\times^3$: Numbers on right refer to Sensitivity
Numbers on left refer to values greater than 120 kPa

$\circ^{3\%}$ STRAIN AT FAILURE

WATER LEVEL RECORDS

Date (dd/mm/yy)/Time	Water Depth (m)	Cave In (m)
1) 10/17/11 1:15:00 PM	DRY	0.7
2)	-	-
3)	-	-

MEL-GEO 11101 - AREA 9 - BOREHOLE LOGS - BAILEY CREEK.GPJ MEL-GEO.GDT 5/14/12

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120 Progress Court, North Bay, On P1A 0C2 Phone: (705)476-2550 Fax: (705)476-8882 Email: northbay@lvm.ca

ENCLOSURE NO.:3 (Pg. 1 of 1)

METRIC

RECORD OF BOREHOLE NO. 2

REFERENCE 11/06/11101-F4 DATUM Geodetic LOCATION N5191675.3 E256458.9 - Ulster Township ORIGINATED BY JL

PROJECT GWP 5046-05-00, Highway 144 - Site No. 46-237 BOREHOLE TYPE Track Mounted CME 45B - Hollow Stem Augers COMPILED BY AT

CLIENT AECOM Inc. DATE (Started) October 17, 2011 TIME (Completed) 2:15:00 PM CHECKED BY MAM

DATE (Completed) October 17, 2011

ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE
408.6	Ground Surface						
0.0	50 mm Asphalt 350 mm Concrete 150 mm Crushed Gravel		1	AS	N/A		
	FILL - sand and gravel trace silt		2	SS	24		
	(compact/dense)		3	SS	36		
406.6							
2.0	Auger Refusal						
404.7							
3.9	DCPT Refusal End of Borehole						

DYNAMIC CONE PENETRATION RESISTANCE PLOT
20 40 60 80 100

SHEAR STRENGTH kPa
○ UNCONFINED + FIELD VANE
● QUICK TRIAXIAL × LAB VANE
20 40 60 80 100

ELEVATION SCALE: 408, 407, 406, 405

PLASTIC LIMIT w_P | NATURAL MOISTURE CONTENT w | LIQUID LIMIT w_L

WATER CONTENT (%)
20 40 60

UNIT WEIGHT γ kN/m^3

REMARKS & GRAIN SIZE DISTRIBUTION (%)
GR SA (SI CL)

COMMENTS

The stratification lines represent approximate boundaries. The transition may be gradual.

$+^3, \times^3$: Numbers on right refer to Sensitivity
Numbers on left refer to values greater than 120 kPa

○ $^{3\%}$ STRAIN AT FAILURE

WATER LEVEL RECORDS

Date (dd/mm/yy)/Time	Water Depth (m)	Cave In (m)
1) 10/17/11 2:15:00 PM	DRY	1.1
2)	-	-
3)	-	-

MEL-GEO 11101 - AREA 9 - BOREHOLE LOGS - BAILEY CREEK.GPJ MEL-GEO.GDT 5/14/12

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ENCLOSURE NO.:4 (Pg. 1 of 1)

METRIC

RECORD OF BOREHOLE NO. 3

L|V|M

REFERENCE 11/06/11101-F4 DATUM Geodetic LOCATION N5191703.2 E256458.6 - Ulster Township ORIGINATED BY JL

PROJECT GWP 5046-05-00, Highway 144 - Site No. 46-237 BOREHOLE TYPE Truck Mounted CME 45B - Hollow Stem Augers COMPILED BY AT

CLIENT AECOM Inc. DATE (Started) October 17, 2011 TIME (Completed) 3:15:00 PM CHECKED BY MAM

DATE (Completed) October 17, 2011

ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L / WATER CONTENT (%)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA (SI CL)
408.7	Ground Surface										
0.0	100 mm Ashpalt 300 mm Concrete 200 mm Crushed Gravel		1	AS							43 53 (4)
407.3	FILL - sand and gravel trace silt (compact)		2	SS	15		408				
1.4	Auger Refusal						407				
405.8							406				
2.9	DCPT Refusal End of Borehole										

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH kPa: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE; 20 40 60 80 100

WATER CONTENT (%): 20 40 60

COMMENTS

The stratification lines represent approximate boundaries. The transition may be gradual.

$+^3$, $\times^3$: Numbers on right refer to Sensitivity
Numbers on left refer to values greater than 120 kPa

$\circ$ $^{3\%}$ STRAIN AT FAILURE

WATER LEVEL RECORDS

Date (dd/mm/yy)/Time	Water Depth (m)	Cave In (m)
1) 10/17/11 3:15:00 PM	DRY	0.9
2)	-	-
3)	-	-

MEL-GEO 11101 - AREA 9 - BOREHOLE LOGS - BAILEY CREEK.GPJ MEL-GEO.GDT 5/14/12

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ENCLOSURE NO.:5 (Pg. 1 of 1)

METRIC

RECORD OF BOREHOLE NO. 4

REFERENCE 11/06/11101-F4 DATUM Geodetic LOCATION N5191712.4 E256454.9 - Ulster Township ORIGINATED BY JL

PROJECT GWP 5046-05-00, Highway 144 - Site No. 46-237 BOREHOLE TYPE Truck Mounted CME 45B - Hollow Stem Augers COMPILED BY AT

CLIENT AECOM Inc. DATE (Started) October 17, 2011 TIME (Completed) 4:10:00 PM CHECKED BY MAM

DATE (Completed) October 17, 2011

ELEV / DEPTH	DESCRIPTION	STRATA PLOT	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES "N" VALUES	GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT / SHEAR STRENGTH kPa	WATER CONTENT (%) (PLASTIC LIMIT w_P, NATURAL MOISTURE CONTENT w, LIQUID LIMIT w_L)	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA (SI CL)
408.7	Ground Surface										
0.0	125 mm Ashpalt 150 mm Crushed Gravel		1	AS							
	FILL - gravel and sand trace silt numerous cobbles/boulders (rock rill)		2	SS	65						51 40 (9)
407.3											
1.4	(very dense) Auger Refusal										
403.4											
5.3	DCPT Refusal End of Borehole										

DYNAMIC CONE PENETRATION RESISTANCE PLOT: 20 40 60 80 100

SHEAR STRENGTH kPa: ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE; 20 40 60 80 100

WATER CONTENT (%): 20 40 60

ELEVATION SCALE: 408 407 406 405 404

COMMENTS

The stratification lines represent approximate boundaries. The transition may be gradual.

$+^3$, $\times^3$: Numbers on right refer to Sensitivity
Numbers on left refer to values greater than 120 kPa

$\circ$ $^{3\%}$ STRAIN AT FAILURE

WATER LEVEL RECORDS

Date (dd/mm/yy)/Time	Water Depth (m)	Cave In (m)
1) 10/17/11 4:10:00 PM	DRY	1
2)	-	-
3)	-	-

MEL-GEO 11101 - AREA 9 - BOREHOLE LOGS - BAILEY CREEK.GPJ MEL-GEO.GDT 5/14/12

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ENCLOSURE NO.:6 (Pg. 1 of 1)

METRIC

RECORD OF BOREHOLE NO. 5

L|V|M

REFERENCE 11/06/11101-F4 DATUM Geodetic LOCATION N5191675.3 E256455.1 - Ulster Township ORIGINATED BY JL

PROJECT GWP 5046-05-00, Highway 144 - Site No. 46-237 BOREHOLE TYPE Coring COMPILED BY AT

CLIENT AECOM Inc. DATE (Started) September 7, 2011 TIME (Completed) CHECKED BY MAM

DATE (Completed) September 7, 2011

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA (SI CL)
ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" VALUES						
408.6	Ground Surface										
0.0	63 mm Asphalt 343 mm Concrete										

COMMENTS

Due to construction of a new slab, after coring and prior to advancing the borehole, the borehole was not advanced further.

The stratification lines represent approximate boundaries. The transition may be gradual.

$+^3$, $\times^3$: Numbers on right refer to Sensitivity
Numbers on left refer to values greater than 120 kPa

○ $^{3\%}$ STRAIN AT FAILURE

WATER LEVEL RECORDS

Date (dd/mm/yy)/Time	Water Depth (m)	Cave In (m)
1)	-	-
2)	-	-
3)	-	-

MEL-GEO 11101 - AREA 9 - BOREHOLE LOGS - BAILEY CREEK.GPJ MEL-GEO.GDT 5/14/12

L|V|M
120 Progress Court, North Bay, On P1A 0C2 Phone: (705)476-2550 Fax: (705)476-8882 Email: northbay@lvm.ca

ENCLOSURE NO.:7 (Pg. 1 of 1)

METRIC

RECORD OF BOREHOLE NO. 6

L|V|M

REFERENCE 11/06/11101-F4 DATUM Geodetic LOCATION N5191703.2 E256455.0 - Ulster Township ORIGINATED BY JL

PROJECT GWP 5046-05-00, Highway 144 - Site No. 46-237 BOREHOLE TYPE Coring COMPILED BY AT

CLIENT AECOM Inc. DATE (Started) September 7, 2011 TIME (Completed) CHECKED BY MAM

DATE (Completed) September 7, 2011

SOIL PROFILE			SAMPLES			GROUND WATER CONDITIONS	ELEVATION SCALE	DYNAMIC CONE PENETRATION RESISTANCE PLOT 20 40 60 80 100 / SHEAR STRENGTH kPa ○ UNCONFINED + FIELD VANE ● QUICK TRIAXIAL × LAB VANE 20 40 60 80 100	PLASTIC LIMIT w_P / NATURAL MOISTURE CONTENT w / LIQUID LIMIT w_L WATER CONTENT (%) 20 40 60	UNIT WEIGHT γ kN/m^3	REMARKS & GRAIN SIZE DISTRIBUTION (%) GR SA (SI CL)
ELEV / DEPTH	DESCRIPTION	STRATA PLOT	NUMBER	TYPE	"N" VALUES						
408.7	Ground Surface										
0.0	100 mm Asphalt 275 mm Concrete										

COMMENTS

Due to construction of a new slab, after coring and prior to advancing the borehole, the borehole was not advanced further.

The stratification lines represent approximate boundaries. The transition may be gradual.

$+^3$, $\times^3$: Numbers on right refer to Sensitivity
Numbers on left refer to values greater than 120 kPa

○ 3% STRAIN AT FAILURE

WATER LEVEL RECORDS

Date (dd/mm/yy)/Time	Water Depth (m)	Cave In (m)
1)	-	-
2)	-	-
3)	-	-

MEL-GEO 11101 - AREA 9 - BOREHOLE LOGS - BAILEY CREEK.GPJ MEL-GEO.GDT 5/14/12

L|V|M
120 Progress Court, North Bay, On P1A 0C2 Phone: (705)476-2550 Fax: (705)476-8882 Email: northbay@lvm.ca

Appendix C Borehole Location Plan Labwork

Figure No. 2: Borehole Location and Soil Strata
Figure No. L-1: Summary Grain Size Analysis Graph
Figure No. L-2: Lab Test Summary Sheet

LVM | MERLEX

METRIC

Dimensions are in meters and/or millimeters unless otherwise shown. Stations are in kilometers + meters.

SITE No	46–237
WP No	5046–05–00
Geocres	42I–288

N

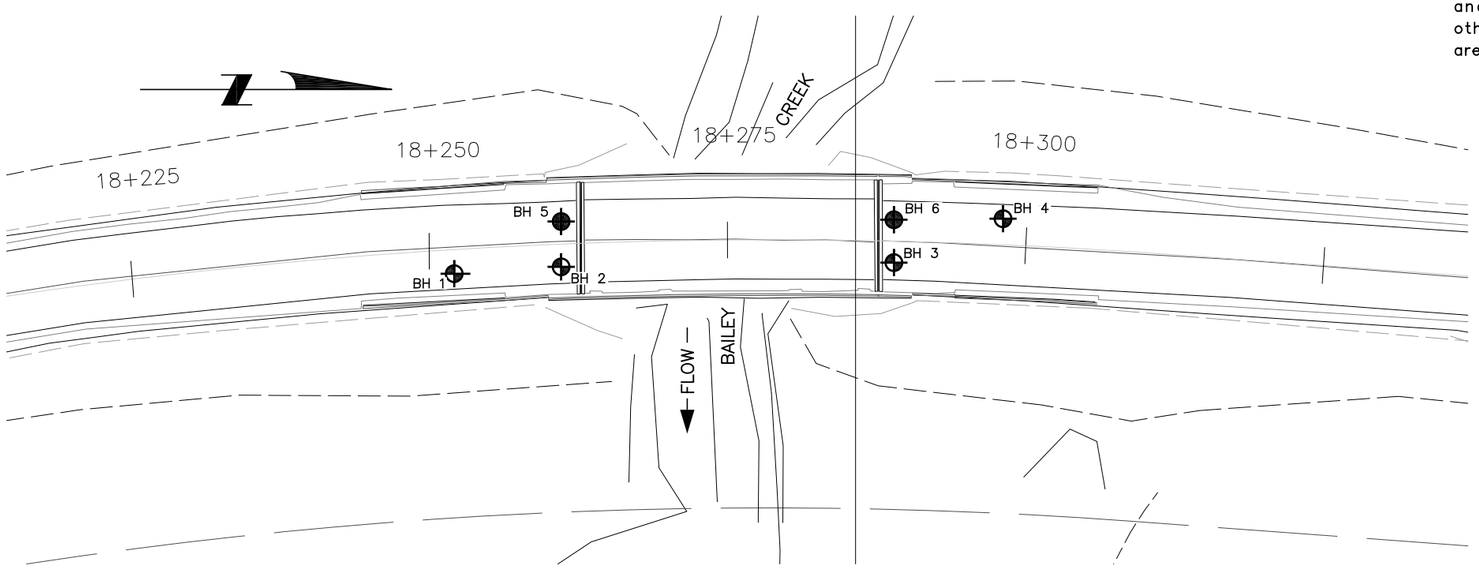
HWY NO. 144 – Township of Ulster

Bailey Creek Bridge
Protection System

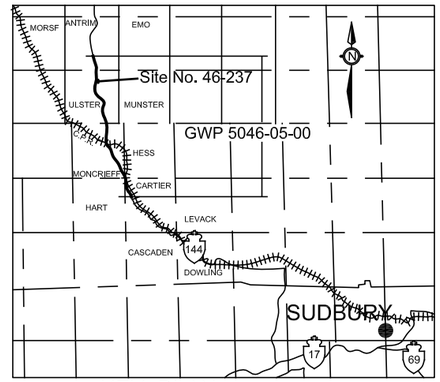
BOREHOLE LOCATIONS & SOIL STRATA

Figure 2

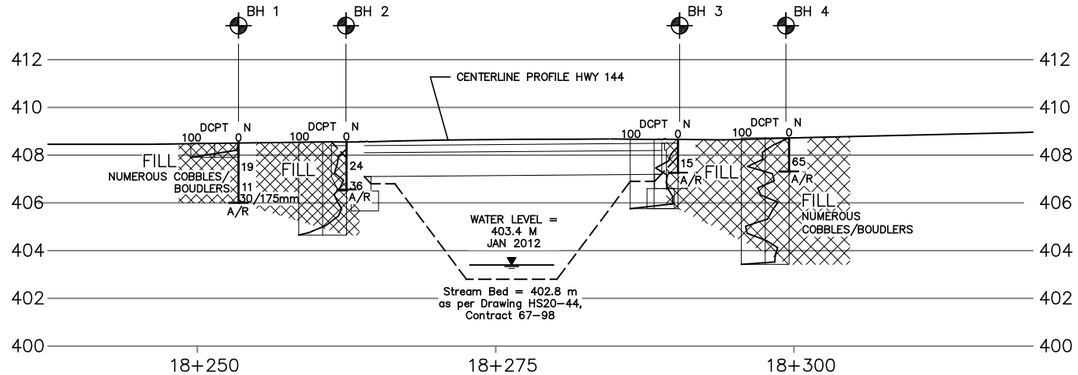
L|V|M | MERLEX



PLAN
SCALE
5m 5m



KEY PLAN – NOT TO SCALE



℄ PROFILE
SCALE
5m 5m HOR
2.5m 2.5m VER

LEGEND

- Borehole
- Dynamic Cone Penetration Test (DCPT)
- Borehole and DCPT
- N — Blows/0.3 m (Std Pen Test, 475 J/blow)
- DCPT — Blows/0.3 m (60° Cone, 475 J/blow)
- Water Level at Time of Investigation
- A/R — Auger Refusal at Elevation
- E/S — End of Sampling

Borehole No.	Elev.	O/S	Co–ordinates Northerly	Co–ordinates Easterly
Borehole No. 1	408.5	2.0m Rt	5191666.4	256459.5
Borehole No. 2	408.6	1.9m Rt	5191675.3	256458.9
Borehole No. 3	408.7	1.8m Rt	5191703.2	256458.6
Borehole No. 4	408.7	2.2m Lt	5191712.4	256454.9
Borehole No. 5	408.6	1.9m Lt	5191675.3	256455.1
Borehole No. 6	408.7	1.8m Lt	5191703.2	256455.0

NOTE 1:
The boundaries between soil strata have been established at the borehole locations only. The boundaries illustrated and stratigraphy between boreholes on this drawing are assumed based on borehole data and may vary. They are intended for design only.

This drawing is for subsurface information only. Surface details and features are for conceptual illustration. The proposed structure location is shown for illustration purposes only and may not be consistent with the final design configuration as shown elsewhere in the Contract Documents.

REVISIONS

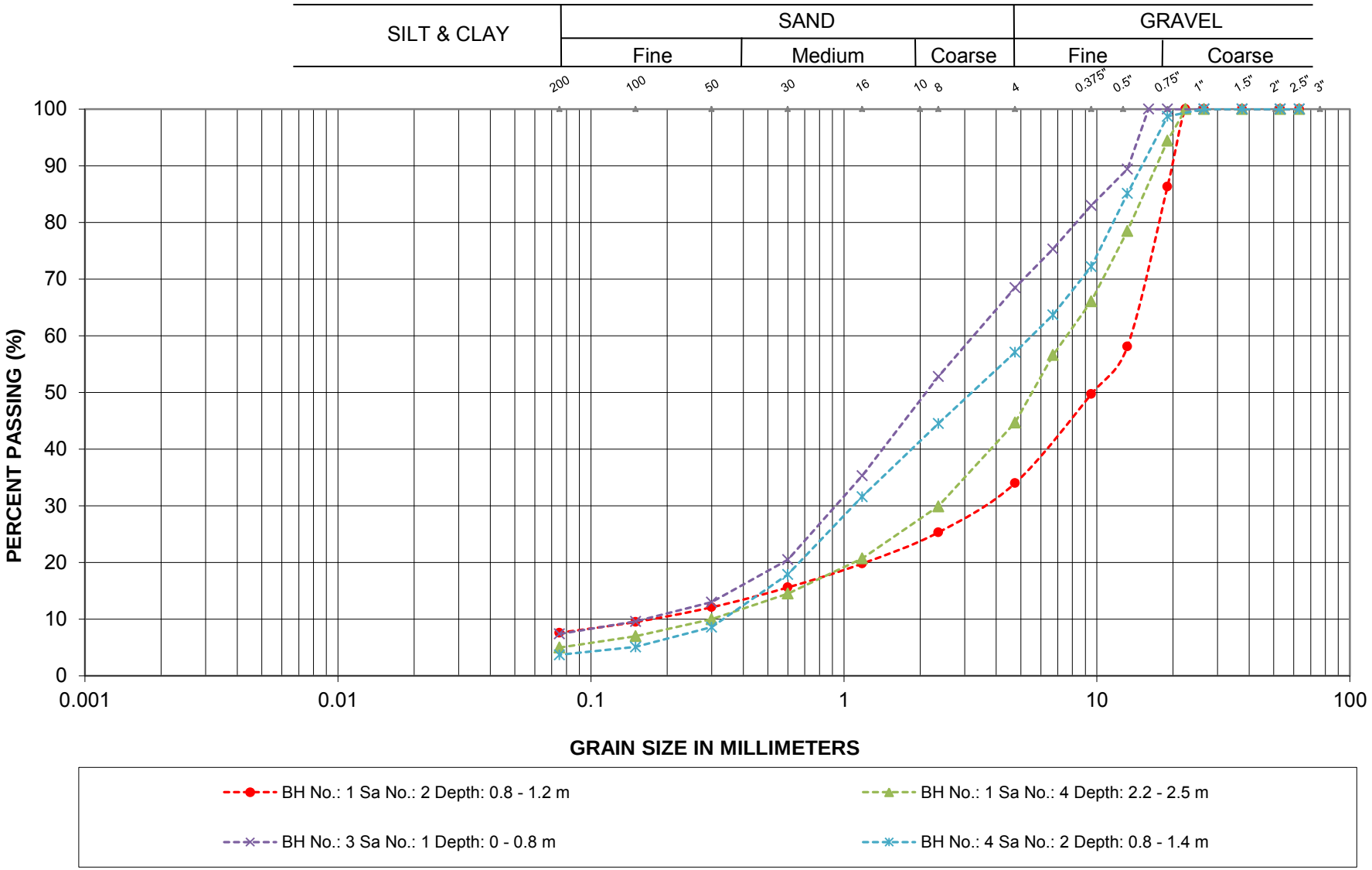
DATE	BY	DESCRIPTION
Jan 2012	RG	DRAFT
Aug 2012	RG	FINAL

HWY No. 144 – Ulster Twp – Bailey Creek Bridge			REF 11101
SUBM'D			SITE 47–237
DRAWN RG	CHK MAM	DATE January 2012	FIG 2

Reference No.: 11/06/11101-F4
Date: September 2012

LVM | MERLEX

GRAIN SIZE ANALYSIS



G.W.P.: 5046-05-00
LOCATION: Hwy 144
SITE: 46-237

FILL

LVM | MERLEX

FIGURE L-1

LVM | MERLEX

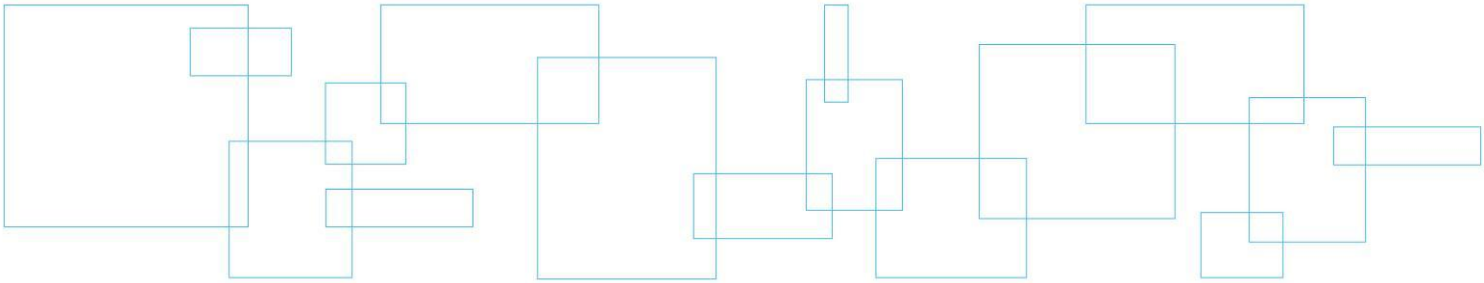
Laboratory Tests - Summary Sheet

Borehole No.	Sample No.	Depth	Grain Size Analysis				NMC	Atterberg Limits			SPT 'N'	USCS	Unit Weight (kN/m3)	Remarks
			Gravel Size (%)	Sand Size (%)	Silt Size (%)	Clay Size (%)		LL (%)	PL (%)	IP (%)				
1	1	0.0					2.2				N/A			
	2	0.8	66	26	8		1.2				19			
	3	1.5					1.7				11			
	4	2.3	55	40	5		2.0				30/ 175mm			
2	1	0.0					4.8				N/A			
	2	0.8					6.4				24			
	3	1.5									36			
3	1	0.0	43	53	4		4.9				N/A			
	2	0.8					8.6				15			
4	1	0.0					2.0				N/A			
	2	0.8	51	40	9		2.9				65			

Appendix D Historical Information

Enclosure No. 8: Contract No. 67-98, Bailey Creek Stratigraphy

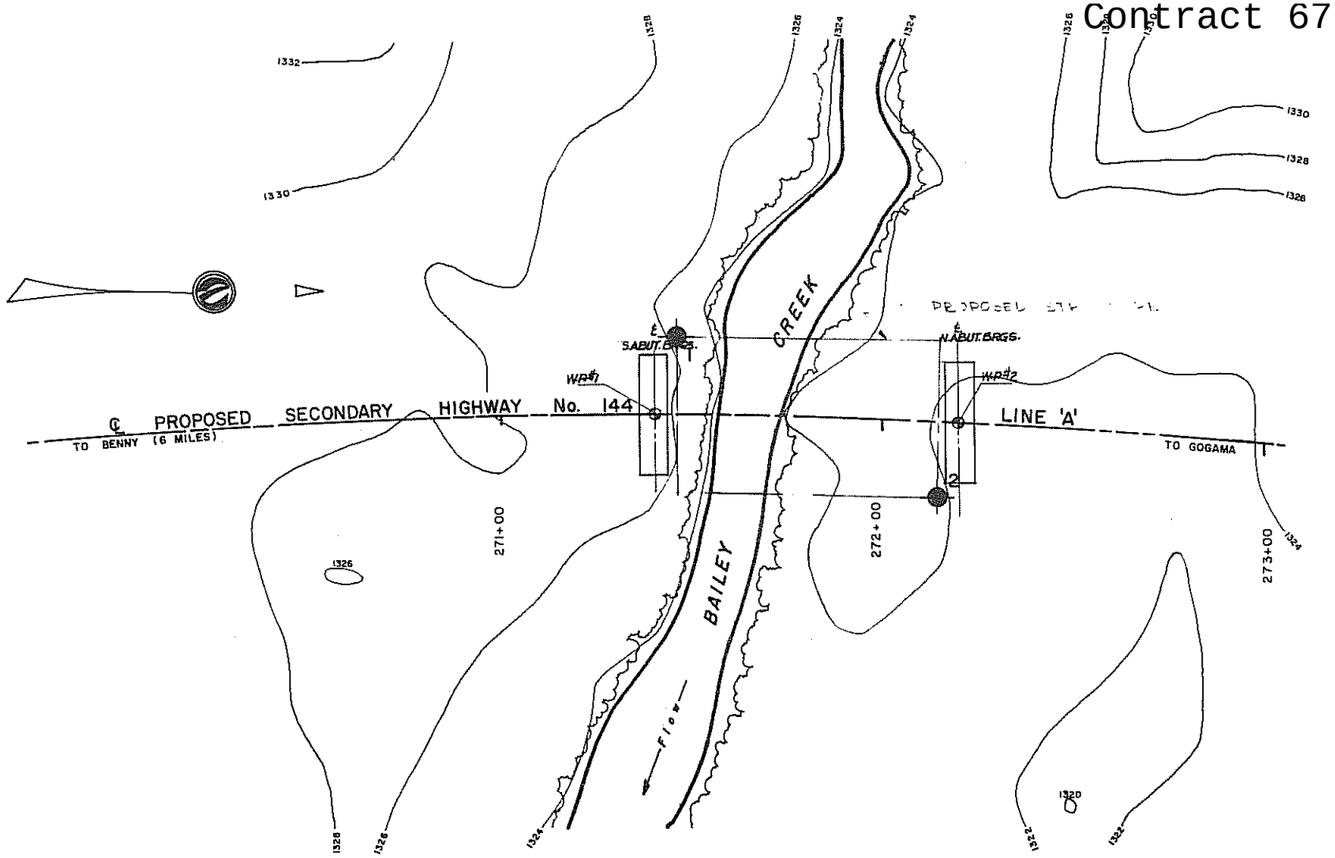
Enclosure No. 9: Contract No. 67-98, Bailey Creek Bridge



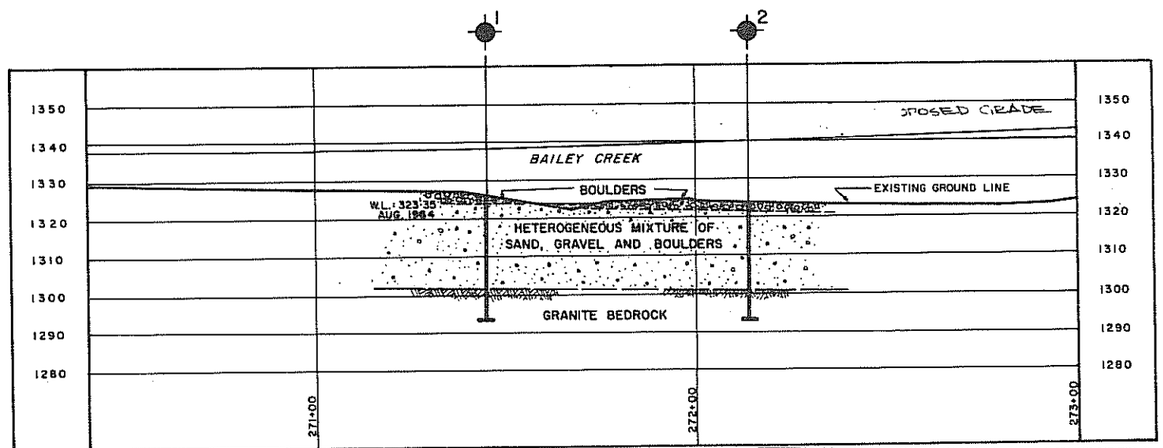
LVM | MERLEX

LVM | MERLEX
Reference No.: 11/06/11101-F4
Hwy 144, Bailey Creek

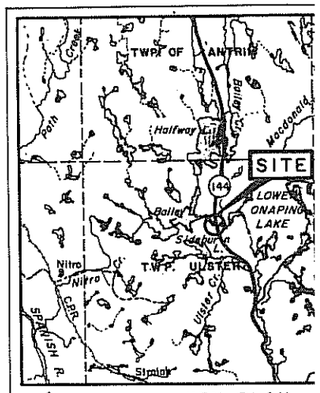
Enclosure No. 8
Contract 67-98



PLAN
SCALE
20 10 0 20 40 FT.



PROFILE
SCALE
20 10 0 20 40 FT.



KEY PLAN
SCALE IN MILES
1 0.5 0 2

LEGEND

- Bore Hole
- Cone Penetration Hole
- Bore & Cone Penetratio
- Water Levels established of field investigation. (J

NO.	ELEVATION	STATION
1	1326·0	271+45
2	1325·0	272+15

— NOTE —
The boundaries between soil strata have be
Bore Hole locations. Between Bore Holes the
from geological evidence and may be subjec

REVISIONS			
	DATE	BY	DESCRIP

DEPARTMENT OF HIGHWAYS
MATERIALS & TESTING DIVISION – FO

BAILEY CR

KING'S HIGHWAY NO. 144 LINE 'A'
DIST. SUDBURY
TWP. ULSTER LOT

BORE HOLE LOCATIONS

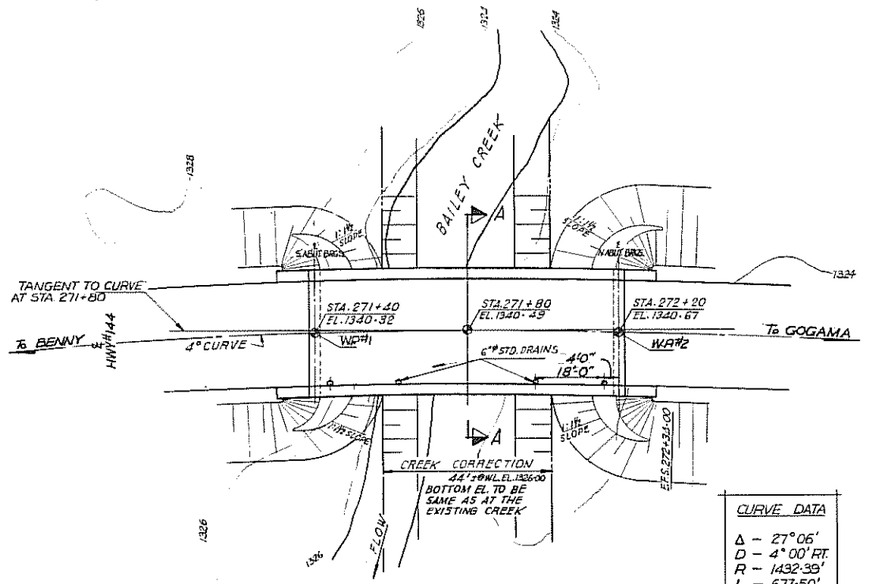
SUBM'D. P.P.	CHECKED [illegible]	W.P. NO. 262-64
DRAWN P.G.O.	CHECKED [illegible]	JOB NO. 66-F-60
DATE JULY 25, 1966		SITE NO 46-237
APPROVED [signature] PRINCIPAL FOUNDATION ENGINEER		CONT NO. 67-98

—NOTE—
The complete soil investigation report for this structure may be examined at the Bridge Office and Foundation Office, Downsview, and at the Sudbury District Office.

REF. NO. E-4410-1

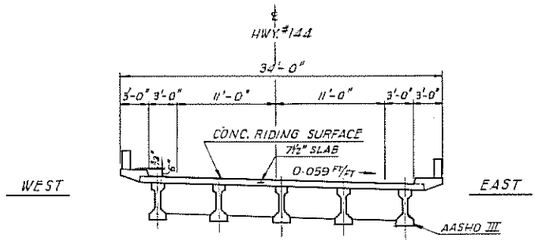
LVM | MERLEX
Reference No.: 11/06/11101-F4
Hwy 144, Bailey Creek

Enclosure No. 9
Contract 67-98

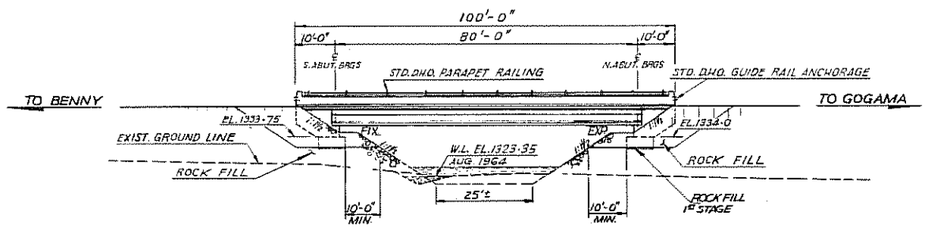


PLAN
SCALE: 1" = 20'

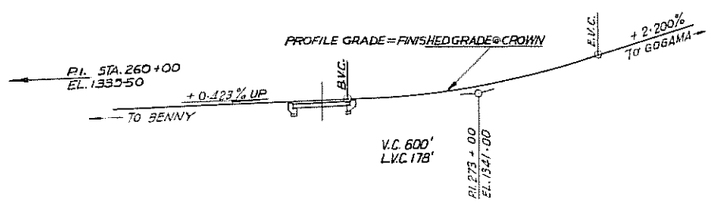
CURVE DATA
Δ – 27°06'
D – 4°00' RT.
R – 1432.39'
L – 677.50'
T – 345.21'
E – 41.01'



SECTION A-A
SCALE: ⅛"=1'-0"



ELEVATION
SCALE: 1" = 20'



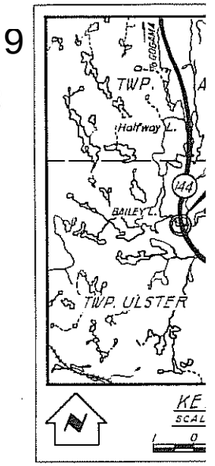
GRADE PROFILE @ ℄ HWY. # 144
N.T.S.

B.M. EL. 1352.72
N. ℄ W. IN 1' N. ROOT OF 0.6' POPLAR
82' RIGHT OF STA. 277+55

LIST OF DRAWINGS

D-6032-1	GENERAL LAYOUT
-2	BORE HOLE LOCATIONS & SOIL STRATA
-3	FOOTINGS & ABUTMENTS
-4	PRESTRESSED GIRDERS & BEARINGS
-5	DECK, DIAPHRAGMS & SCREED ELEVATIONS
-6	PARAPET WALL DETAILS
-7	STANDARD STEEL PARAPET RAIL
-8	STANDARD DETAILS

REGISTERED PROFESSIONAL ENGINEER — CIVIL — K. Z. STOLARSKI — PROVINCE OF ONTARIO



CLASS OF CONCRETE
DECK, CURBS & PARAPET WALL — 400
REMAINDER — 300
FOR PRESTRESSED GIRDERS SEE DWG

CLEAR COVER ON REINFORCING STEEL
FOOTINGS — 3"
ABUTMENTS — 3"
DECK TOP — 1½"
BOTTOM — 1"
DIAPHRAGMS & CURBS — 2"
AND/OR AS NOTED ON DRAWINGS

CONSTRUCTION NOTES
THE CONTRACTOR IS RESPONSIBLE FOR FINISHING THE BEARING SEATS DEAD LE TO THE SPECIFIED ELEVATIONS WITH A TOLERANCE OF ± 1/8 INCH.

NO CONCRETE SHALL BE PLACED ABOV ABUTMENT BEARING SEATS UNTIL TH CONCRETE IN THE DECK HAS BEEN

REVISIONS			
	DATE	BY	DESCRIPT

DEPARTMENT OF HIGHWAY
BRIDGE DIVISION

BAILEY CREEK BRI
5.8 MI. NORTH OF BENNY

KING'S HIGHWAY No. 144
DIST. OF SUDBURY
TWP. ULSTER — LOT

GENERAL LAYOU

APPROVED — BRIDGE ENGINEER

DESIGN	K.Z.S.	CHECK	P.O.L.	SITE No.
DRAWING	L.S./F.R.	CHECK	K.Z.S.	CONTRACT No.
DATE	JAN. 1967	LOADING	HS20-44	DRAWING No.